

REMARKS

Applicants have amended their claims by adding new claims 28 and 29 to the application. Claim 28, dependent on claim 1, recites that the composition has the property that it is cured by irradiation with light; and claim 29, dependent on claim 28, recites that the composition has the property that it is cured by irradiation with ultraviolet light. Note, for example, pages 2 and 3 of Applicants' specification, together with, for example, the description on pages 15 and 16 thereof. Note also, for example, Example 1 on page 23 of Applicants' specification.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed January 9, 2008, that is, the U.S. patent documents to Amagai, et al., Patent No. 5,807,975, to Hojo, et al., Patent Application Publication No. 2003/0129385, and to Ishii, et al., Patent Application Publication No. 2003/0195270, and the article by Tachi, et al., "Photochemical Reactions of Quaternary Ammonium Dithiocarbamates as Photobase Generators and Their Use in the Photoinitiated Thermal Crosslinking of Poly(glycidyl methacrylate)", in J. Polymer Science Part A, Vol. 39 (2001), pages 1329-41, under the provisions of 35 USC 103.

It is respectfully submitted that the references as applied by the Examiner would have neither disclosed nor would have suggested such photocurable composition as in the present claims, having, in addition to an episulfide compound containing a thiirane ring, a photo-base generator represented by the general formula (1) in claim 1, with $(-A^+)$ being an ammonium ion selected from the group consisting of those represented by the structural formulae (2) set forth in claim 1. See claim 1.

It is emphasized that the present invention is directed to a photocurable composition, more particularly, the composition has the property that it is cured by irradiation with light (see claim 28), in particular, has the property that it is cured by irradiation with ultraviolet light (see claim 29). As will be discussed in more detail in the following, the applied primary reference to Amagai, et al. provides no mention of photocuring; and, more specifically, discloses, for example, in column 12, lines 54 and 55, a polymerizing/curing reaction by heating (that is, thermal curing). As discussed further infra, the secondary applied references, including Tachi, et al., which does not describe an episulfide compound, would have neither disclosed nor would have suggested the photocurable composition as in the present claims, including the episulfide compound and the photo-base generator.

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a photocurable composition as in the present claims, having features as discussed previously in connection with claim 1, and, moreover, wherein X^- of the structural formulae (2) is selected from the group consisting of borate anion, an N,N-dimethylcarbamate anion, a thiocyanate anion and a cyanate anion (see claim 27), in particular, wherein X^- is a borate anion (see claim 3).

Furthermore, it is respectfully submitted that these references as applied by the Examiner would have neither taught nor would have suggested such photocurable composition as in the present claims, having features as discussed previously in connection with claim 1, and, in addition, wherein the photo-base generator is capable of generating at least one of the specified compounds recited in claim 26, upon irradiation of ultraviolet rays; and/or wherein the composition has the property that it is

cured by irradiation with light (see claim 28), in particular, by irradiation with ultraviolet light (see claim 29).

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such photocurable composition as in the present claims, having features as discussed previously in connection with claim 1, and, furthermore, having additional features as in the dependent claims reciting the photocurable composition, including (but not limited to) wherein Ar is further defined as in claim 2; and/or wherein the compound (A) is a compound having at least one structure represented by the structural formula (3) in claim 4, more specifically, wherein the compound (A) is represented by the general formula (4) in claim 5, with the integers n and m being that set forth in claim 6; and/or wherein the composition further includes a solvent capable of dissolving the photo-base generator, as set forth in claim 7.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested a method for curing the photocurable composition discussed previously in connection with claim 1 or 7, by irradiation of ultraviolet rays (see claims 8 and 16), or wherein the composition is cured in the absence of air (see claims 9 and 19).

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such cured product as in the present claims, made by the methods of claim 8 (note claim 15), of claim 16 (note claim 17), of claim 9 (note claim 18), or of claim 19 (note claim 20).

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such a coating composition as in the present claims, including the photocurable composition as in

claim 1 or 7, and (C) a modified silicone oil (note claims 10 and 21), and (D) a silane coupling agent (note claims 11 and 22); and/or a method of curing the coating composition by irradiation of ultraviolet rays (note claims 12 and 13), particularly with such irradiation occurring in the absence of air (note claim 13); and/or the cured or optical product made by the aforementioned methods of claims 12 and 13, as in claims 23-25.

Furthermore, even assuming, arguendo, that the teachings of the applied references would have established a prima facie case of obviousness, it is respectfully submitted that the evidence of record in the above-identified application, that is, the evidence in Applicants' specification (the Examples and Comparative Examples on pages 22-36 of Applicants' specification), shows unexpectedly better results achieved by the present invention, utilizing the recited episulfide compound containing thiirane ring and the recited photo-base generator, in achieving a photocurable composition, overcoming any possible prima facie case of obviousness established by the teachings of the applied references. In this regard, it is respectfully submitted that the evidence in Applicants' specification must be considered in determining patentability of the presently claimed subject matter. See In re DeBlauwe, 222 USPQ 191 (CAFC 1984). Properly considered, it is respectfully submitted that this evidence shows unexpectedly better results achieved by the present invention, utilizing the photo-base generator recited therein, as compared with using other generators, and clearly supports patentability of the presently claimed subject matter.

Thus, note that Comparative Examples 2-5, on pages 24-27 of Applicants' specification, utilize photo-acid generators. It is respectfully submitted that these Comparative Examples are closer than the closest prior art, i.e., the teachings of

Amagai, et al. Note Table 1-2 on page 28 of Applicants' specification. As can be seen therein, the curing condition shows that upon curing examples within the scope of the present invention, no tackiness occurred (full curing occurred); while in curing the compositions in Comparative Examples 2-5, tackiness occurred (complete curing did not occur). It is respectfully submitted that this evidence in Applicants' specification shows unexpectedly better results (unexpectedly better curing) achieved by the present photocurable composition.

On page 12 of the Amendment filed November 26, 2007, Applicants have relied upon the evidence in their specification as showing unexpectedly better results; however, the Examiner has failed to comment on this evidence, in the Office Action mailed January 9, 2008. Such failure by the Examiner to address evidence of unexpectedly better results of record in the above-identified application is clearly improper. Note Manual of Patent Examining Procedure (MPEP) 716.01(a). Note especially the statement therein that "Examiners must consider comparative data in the specification which is intended to illustrate the claimed invention in reaching a conclusion with regard to the obviousness of the claims". It is respectfully submitted that upon proper consideration of the evidence in Applicants' specification, the obviousness rejection will be overcome, even if a prima facie case of obviousness has been made.

The present invention relates to photocurable compositions, and coating compositions, useful for producing various optical products such as optical adhesives, optical coating materials, optical fibers, filters and plastic lenses, among other products, methods of curing such compositions, and the cured product formed from such composition.

Plastic materials have been recently used as various optical materials because of light weight, high tenacity and easy-dyeability. Various methods for photocuring episulfide compounds have been disclosed, as described in the paragraph bridging pages 1 and 2 of Applicants' specification.

Moreover, as will be discussed further infra, a photo-base generator which is a quaternary ammonium salt with N,N-dimethyldithiocarbamate has been described as a photo-base generator for photo-initiated thermal crosslinking of poly(glycidyl methacrylate).

Furthermore, episulfide compounds have previously been cast into a so-called mold and then polymerized and cured therein to obtain a cured product thereof. Owing to the remarkably high refractive index of these episulfide compounds, there is a strong demand for applying the episulfide compounds as a coating material for various substrates. However, since coating materials made of the episulfide compound generally exhibit a poor wetting property to various substrates, it is difficult to stably form a thin film having a thickness of from several μm to several tens μm , of the episulfide compound.

Against this background, Applicants have solved the foregoing problems by the present invention. Specifically, according to one aspect of the present invention, Applicants have found that by using a photo-base generator represented by the general formula (1) in claim 1, together with an episulfide compound containing a thirane ring, an episulfide composition capable of being readily cured by irradiation of ultraviolet rays, and having a high refractive index, is achieved. Moreover, according to another aspect of the present invention, a coating composition containing the episulfide compound and capable of being readily cured by irradiation of ultraviolet rays, and having a high

refractive index, can be achieved. See, e.g., the paragraph bridging pages 2 and 3 of Applicants' specification.

Applicants have further found that when the thiirane ring-containing compound is that set forth in formula (3) (note claim 4), the resultant photocurable composition is more suitable as a photocurable composition since a cured product obtained therefrom can exhibit a higher refractive index. See, e.g., the paragraph bridging pages 3 and 4 of Applicants' specification.

In addition, Applicants have found that by adding a modified silicone oil to this photocurable composition including the specified episulfide compound and the specified photo-base generator, the composition is suitable as a coating composition since the composition shows a good wetting property to various substrates. See page 4, lines 5-9, of Applicants' specification.

Moreover, Applicants have found that by including a silane coupling agent in the coating composition, a coating film having excellent uniformity and adhesion property is achieved, as described in the paragraph bridging pages 19 and 20 of Applicants' specification.

Amagai, et al. discloses alkyl sulfide type episulfide compounds which can be suitably used as an optical material, the episulfide compounds being represented by general formula (I) or (II) as set forth most generally in column 3, lines 1-16, of this patent. This patent discloses that an optical material is obtainable by polymerizing and curing the alkyl sulfide type episulfide compound represented by the general formula (I) or (II). Note column 3, lines 47-50. See also column 3, lines 54-63. This patent goes on to disclose that the described episulfide compounds can be polymerized/cured in the presence of a curing catalyst to prepare an optical material, any of the known curing

catalysts for epoxy resins being used (see column 9, lines 51-57); and that the alkyl sulfide type episulfide compound can be cured/polymerized with a compound having two or more functional groups which can react with an episulfide group, or a compound having one or more of these functional groups and one or more of other homopolymerizable functional groups (see column 12, lines 6-17). Various curing catalysts are disclosed from column 9, line 57, to column 12, line 3, of Amagai, et al.

Amagai, et al. discloses polymerizing/curing of the episulfide compound; however, it is noted that, e.g., in Example 1 in columns 13 and 14 of this patent, the polymerization/curing was performed at a relatively high temperature of 80°C, i.e., thermal curing. It is respectfully submitted that Amagai, et al. has no disclosure of photocuring. It is respectfully submitted that this reference does not disclose, nor would have suggested, such photocurable composition as in the present claims, especially having the property that it is cured by irradiation with (ultraviolet) light, and including wherein a specified photo-base generator forms part of the composition, or the curing method, including wherein the curing is performed using ultraviolet radiation, or the cured product.

Note that Amagai, et al. discloses a great many specific examples of curing catalysts, from column 9, line 59, through column 12, line 3. These include quaternary ammonium salts of specific amines (previously disclosed in Amagai, et al.) and halogens, mineral acids, Lewis acids, organic acids, silicic acids, boron tetrafluoride and the like. Note column 11, lines 53-56. In view of the many catalysts described in Amagai, et al., it is respectfully submitted that this reference would have neither disclosed nor would have suggested, nor would have directed one of ordinary skill in the art to, specific photo-base generators, such as those described in Tachi, et al.,

discussed infra, even in light of the teachings of Tachi, et al.; nor would have provided any expectation as to the better results in curing properties achieved according to the present invention, by the photocurable composition of the present claims including the episulfide compound in combination with the photo-base generator.

Thus, and among other features of the present invention, it is respectfully submitted that Amagai, et al. would have neither taught nor would have suggested a photocurable composition as in the present claims, or method of curing the composition including irradiation with light, in particular ultraviolet light, or wherein the composition has the property that it is cured by irradiation with (ultraviolet) light, and advantages due thereto; or even wherein the composition includes a photo-base generator together with the episulfide compound, as in the present claims.

It is respectfully submitted that the additional teachings of the secondary references as applied by the Examiner would not have rectified the deficiencies of Amagai, et al., such that the presently claimed invention as a whole would have been obviousness to one of ordinary skill in the art.

Tachi, et al. reports on photo products of quaternary ammonium dithiocarbamate and their application to photo-initiated thermal crosslinkers for poly(glycidyl methacrylate) (PGMA). Note, in particular, the first paragraph in the left-hand column on page 1330 of this article. The article describes a photo irradiation method in the left-hand column on page 1333. In summary, this article discloses that the quaternary ammonium salts with phenacyl groups and N,N-dimethyldithiocarbamate anions are good photo-base generators, for PGMA, that produce tertiary amines. Note the "SUMMARY" in the left-hand column on page 1341 of this article.

Initially, it is emphasized that the article discloses that quaternary ammonium salts with N,N-dimethyldithiocarbamate are photobase generators for photo-initiated thermal crosslinking of poly(glycidyl methacrylate). This article does not disclose any effect of the crosslinking agent on optical properties, Tachi, et al. not disclosing optical properties at all. Noting that Amagai, et al. specifically discloses thermal curing, and that the article by Tachi, et al. does not mention at all an optical material, e.g., having high refractive index, or even episulfide compounds, much less episulfide compounds having a thirane ring, it is respectfully submitted that one of ordinary skill in the art concerned with in Amagai, et al. would not have looked to the teachings of Tachi, et al. In other words, it is respectfully submitted that these references are directed to non-analogous arts.

Moreover, it is respectfully submitted that the Examiner has pointed to no proper reason, based upon the teachings of the applied references to one of ordinary skill in the art, for applying the teachings of Tachi, et al. to the teachings of Amagai, et al.. In this regard, it is respectfully submitted that only through hindsight use of Applicants' invention, which of course is improper under the requirements of 35 USC 103, would one of ordinary skill in the art have applied the teachings of Tachi, et al. to Amagai, et al.

Furthermore, it is again emphasized that Tachi, et al. is directed to photo-initiated thermal crosslinking for poly(glycidyl methacrylate). It is respectfully submitted that episulfide compounds as in Amagai, et al. are quite different in properties than poly(glycidyl methacrylate). Thus, "S" is quite different from "C" in properties thereof, because they belong to different groups. Furthermore, the episulfide compound as in the present claims has a thirane ring, whereas poly(glycidyl methacrylate) in Tachi, et

al. does not have a thiirane ring. Particularly in view thereof, it is respectfully submitted that there would have been no reason for one of ordinary skill in the art concerned with in Amagai, et al. to have looked to the teachings of Tachi, et al., absent the description in Applicants' disclosure of their invention, which of course cannot provide a reason for combining teachings of references.

On page 3 of the Office Action mailed January 9, 2008, the Examiner recognizes that Amagai, et al. "[fails] to disclose the photobase generator of formula (1) in claim 1 of the instant application", but notes that Tachi, et al. discloses a process of curing poly(glycidyl methacrylate) and the use of quaternary ammonium salts of formula (I) as photo-base generators. The Examiner goes on to state in the paragraph bridging pages 3 and 4 of the Office Action mailed January 9, 2008, that it would have been obvious to use the quaternary ammonium salts disclosed Tachi, et al. as curing catalyst/photo-base generators for the episulfide compounds with thiirane rings of Amagai, et al., "based on Amagai's teachings that any curing catalyst used for curing epoxy products can be used to cure the episulfide compounds", the Examiner pointing to column 9, lines 54-56 of Amagai, et al.

However, as mentioned previously, the episulfide compound is quite different from the poly(glycidyl methacrylate) in Tachi, et al., from a view point of chemical structure; and, moreover, Tachi, et al. does not discuss optical materials, much less optical materials having high refractive index. It is respectfully submitted that one of ordinary skill in the art, e.g., in connection with optical materials and compositions for producing such materials, even with the teachings of Amagai, et al. and Tachi, et al. in front of him, would not have looked to application of Tachi, et al. to episulfide

compounds having a thiirane ring, even in light of the disclosure at column 9, lines 54-56, of Amagai, et al.

Particularly in view of the unexpectedly better results achieved according to the present invention, utilizing the composition (that is, combination of components) as in the present claims, any conclusion of a prima facie case of obviousness established by combining the teachings of Amagai, et al. and Tachi, et al. is overcome.

Moreover, clearly the combined teachings of Amagai, et al. and of Tachi, et al. would have neither taught nor would have suggested the compositions with anions X⁻ as in claims 3 and 27.

It is again emphasized that Amagai, et al. has no disclosure, or any mention, of photocuring, in connection with curing the described episulfide compounds, Amagai, et al. having thermal curing. In contrast, Tachi, et al. discloses quaternary ammonium salts with dithiocarbamate anions acting as photoinitiated thermal crosslinkers for poly(glycidyl methacrylate) films. It is respectfully submitted that absent Applicants' disclosure, there would have been no motivation to combined the teachings of Amagai, et al., which do not even mention photocuring at all, with the teachings of Tachi, et al., describing specific quaternary ammonium salts acting as photoinitiators.

Moreover, as a person of ordinary skill in the art in connection with Amagai, et al., would never have been motivated to combine the teachings thereof with the teachings of Tachi, et al., it is respectfully submitted that such person would never have considered using the quaternary ammonium salts mentioned in Tachi, et al., in compositions of Amagai, et al., from the quaternary ammonium salts disclosed in Amagai, et al.

Furthermore, the unexpectedly better results achieved according to the present invention are again noted. Even combining the teachings of Amagai, et al. and Tachi, et al. as applied by the Examiner, it is respectfully submitted that one of ordinary skill in the art would never expect the excellent curing properties obtained through use of the composition having the photo-base generator represented by the general formula (1) as in the present claims, together with the episulfide compound containing a thiirane ring as in the present claims.

It is respectfully submitted that the teachings of the additional secondary references applied by the Examiner, that is, Ishii, et al. and Hojo, et al. would not have rectified the deficiencies of the teachings of Amagai, et al. and Tachi, et al., with respect to the rejections set forth in Items 5 and 6 on pages 7-10 of the Office Action mailed January 9, 2008, such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Hojo, et al. discloses photocurable resin compositions suitable for formation of a finely embossed surface structure on an optical article, wherein in a first aspect the composition includes, as essential components, (A) a binder resin having photopolymerizable functional groups and (B) inorganic superfine particles in the order of sub-micron which can be dispersed in a colloidal form in a diluting solvent for preparation of a coating liquid. See paragraph [0031] on page 3 of Hojo, et al. Note also paragraphs [0032] and [0037] on page 3 of this document. This patent document also discloses that a release agent may be blended with the photocurable resin composition, and that by blending the release agent with the photocurable resin composition a partial remain of the photocurable resin in a press stamper pressed against the resin can be prevented when the press stamper is removed (see

paragraph [0148] on page 12); and that a silicone-type release agent is particularly preferable, the silicone-type release agent including polysiloxane, modified silicone oil, trimethyl siloxy silicic acid-containing polysiloxane, silicone-type acrylic resin, etc. (see paragraph [0150] on page 12 of this patent document). Moreover, Hojo, et al. discloses that an organometallic coupling agent may be incorporated into the photocurable resin composition in order to improve heat resistance and strength of the surface structure having a finely embossed pattern, or adhesion thereof to a metal-deposited layer. See paragraph [0163] on page 13 of Hojo, et al.

Ishii, et al. discloses sulfur-containing polyenic compounds and photocurable compositions of these, useful for optical materials such as a spectacle lens, a prism, an optical fiber, an information recording substrate and a filter and useful for coating materials, adhesives and encapsulants for optical materials, the photocurable compositions containing 3,3'-thiobis(propane-1,2-dithiol) of a specified formula set forth in paragraph [0010] on page 1 of this patent document. See also paragraphs [0017]-[0019] on page 2 of Ishii, et al. Note also paragraph [0050] on page 5, and paragraph [0119] on page 21 of this patent document, the later paragraph describing a method of molding the cured product.

Even assuming, arguendo, that the teachings of Hojo, et al. and of Ishii, et al. were properly combinable with the teachings of Amagai, et al., Applicants maintain their contention that the teachings of Amagai, et al. and of Tachi, et al. would not have been properly combinable. And even if the teachings of all of these reference were properly combinable, the combined teachings of the three (3) or four (4) references as applied by the Examiner would have neither disclosed nor would have suggested the presently claimed invention, including the photocurable composition, or method wherein the

composition is cured by irradiation with ultraviolet light, particularly wherein the irradiation is performed in the absence of air; or other features of the present invention as discussed previously, including, inter alia, wherein the photocurable composition has the property that it is cured by irradiation with light (in particular, cured by irradiation with ultraviolet light).

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently pending in the above-identified application are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.136. Kindly charge any shortage of fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout & Kraus, LLP, Account No. 01-2135 (case 396.45781X00), and please credit any overpayments to such Deposit Account.

Respectfully submitted,

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